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Proceedings and Recommendations
of the
Third Ashland Conference
on
Western Forest Insect Problems
1919.

January, 1920.

A.J. Jarvi

Secretary of
1919 Conference.

Index

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FOREST INSECT
LABORATORY

PROCEEDINGS AND RECOMMENDATIONS
of the
THIRD ANNUAL ASHLAND CONFERENCE
at
ASHLAND, OREGON.
NOVEMBER 18-24, 1919.

(An informal conference between Bureau of Entomology
and Forest Service representatives for the discussion
of western forest insect control problems)

Participants:-

Bureau of Entomology, (Branch of Forest Insects)

John M. Miller, Assistant Forest Entomologist,
and in charge of Pacific Slope Station
at Ashland, Oregon.

James Evenden, In charge of Forest Insect
Field Station at Coeur D'Alene, Idaho.

J. E. Patterson, Attached to the Pacific
Slope Station at Ashland, Oregon.

Forest Service,

Wallace Pearce, In charge of insect control
in D.- 2.

Ralph Hopping, In charge of insect control
in D.- 5.

A. J. Jaenike, In charge of insect control
in B.- 6.

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FOREWORD

The first so-called Ashland Conference was held in January, 1917, at Ashland, Oregon, primarily at the suggestion of Dr. A. D. Hopkins, and was attended by John M. Miller of the Bureau of Entomology, and Messrs Ralph Hopping of D-5 and A. J. Jaenicke of D-6. This meeting resulted in the formulation of the "Ashland Conference Plan" which subsequently received the approval of Dr. Hopkins of the Bureau of Entomology after his careful revision and reorganization of the material, and the Forester. Its two main purposes, as quoted from the Plan itself, are:

1. "The determination and practical application of information on the most economical and efficient methods of conducting control operations against the *Dendroctonus* beetles".
2. "The carrying out of experiments and investigations to determine the most effective methods of applying the percentage principle of control to the various technical and practical features of control".

The main features of the investigations contemplated by the Plan are:

1. "Selection of two control areas to be designated as Area A and Area B, and one check area to be designated as Area C, in District 5 or in District 6, embodying typical epidemic infestations by *Dendroctonus brevicornis* in yellow pine, or if possible the selection of two sets of such areas".
2. "Carrying out of control work on the control areas in accordance with the methods described in the Plan".
3. "Collection of data on the control areas and check areas during the years previous, during, and subsequent to control work, and the necessary marking and tagging of the trees".
4. "Interpretation of the data obtained".

The objects of these experimental areas are:

"Area A - to determine the effectiveness of a given percentage and the proper methods of application.

"Area B - to determine the extent of a sphere of influence, or what constitutes an infestation unit best suited for control operations.

"Area C - to give data on the progress of an undisturbed infestation to be used in assisting in the interpretation of the results on the two classes of control areas, and to give specific data on the average annual loss in an uncontrolled infestation".

The necessary characteristics of such experimental areas, the methods of collecting data, and the detailed procedure are all stated quite fully in the original Ashland Conference Plan, copies of which are to be found in the Forest Service and Bureau of Entomology files. It is significant that the three years of experience since 1917 by the Bureau of Entomology and Forest Service officials engaged in forest insect control work on the Pacific Coast have not revealed any necessity for the alteration of the original Conference Plan, aside from its enlargement to broaden its scope.

The only Conference Plan project carried out thus far is an Area A known as the Kaweah control project on the Sequoia National Park and Sequoia National Forest which cost the National Park Service and the Forest Service a total of \$1600.00 in 1918 for control operations.

The Second Annual Ashland Conference was called in December, 1918, for the compilation and preliminary interpretation of the considerable quantity of carefully collected data available on this project, as well as the consideration of further plans for the execution of work under the Ashland Conference Plan. The meeting was attended by John M. Miller of the Bureau of Entomology, and by Ralph Hopping and A. J. Jaenicke of the Forest Service, and resulted in a report entitled "Progress Report on the Ashland Conference Plan Projects", copies of which are both in the bureau of Entomology and Forest Service files.

The Third Annual Conference of this kind, the sessions of which have just ended, was much broader in its scope than either of the two previous ones. In the first place, it was possible because of the enlarged Bureau of Entomology and Forest Service representation to discuss in some detail the insect problems on the National Forests in

Districts 1, 2, 3, 5, and 6, and the situation on the private timber lands within the geographical boundaries of these Districts.

The more salient features of these discussions will be brought out in other reports, and therefore only brief mention will be made of them in this conference description. Methods of insect reconnaissance, the administrative and technical features of control operations, the nature of the problems on which further detailed investigations by the Bureau of Entomology are contemplated, are some of the matters which were gone over in some detail, and which will not be reviewed in this report. The most important work of the conference was the outlining of an enlarged insect control policy, and it is this feature of the meeting which will receive the greatest share of attention in this brief report.

The meeting proved of the greatest value not only in establishing cordial personal relations between the men of the two Bureaus, but in addition it served to bring about a much better understanding of the legitimate field of activity of each of the two Bureaus in the forest insect problem. Then too there is now in effect as a result of the Third Ashland Conference, a uniform scheme for the collection of data on both worked and unworked infestations which will greatly simplify the interpretation of these data no matter where they originate. An annual meeting of this kind is of such great benefit in coordinating and developing the work of the Bureau of Entomology and the Forest Service in forest insect problems that they should continue to be participated in by all the men in the Branch of Forest Insects in directive capacities in the West and the insect control men of the various Districts in the Forest Service organization.

The resignation of Mr. Ralph Hopping, in charge of insect control work in California was announced at the conference. By Mr. Hopping's resignation the Forest Service loses its most experienced insect control man. Mr. Hopping's exceptionally intimate knowledge of California conditions makes him an unusually difficult man to satisfactorily replace. Fortunately Mr. Hopping has in the past given attention to training a few of the Forest Service men in insect control problems. The execution of the proposed enlargement of insect control activity in California will not therefore present unsurmountable difficulties, especially since Mr. John M. Miller, of the Bureau of Entomology, plans to give the California problems even more of his personal attention in the

future than in the past to the extent of establishing and personally directing a Field Station in the spring of 1920 in the southern Sierras of California. A special effort will be made to secure the attendance of Mr. Hopping at future conferences. His help in the formulation of the original Plan and the subsequent field work and discussions has been invaluable. In many respects the British Columbia forest insect problems which he will study are similar to those under consideration in this country.

Mr. Miller deserves special commendation for guiding the program of this conference in such an able manner and for outlining so clearly to the conference the attitude of his Chief, Dr. A. D. Hopkins, on the more important matters which came up for discussion.

Forest Examiner A. J. Jaenicke of District Six was appointed secretary of the Conference and to him was delegated the work of organizing the Conference report, and summarizing the data and recommendations presented at the Conference sessions. Inasmuch as the responsibility for the various papers is plainly indicated in this report, the Conference agreed, in order to avoid delay, that the signatures of the various participants in the meeting could properly be dispensed with.

Part I of the report deals with the survey and control work recommended in California for the calendar year 1920. Part II consists of the summaries of the papers presented by the Ashland and Coeur d'Alene stations. Part III includes the material contributed by the Forest Service representatives, and Part IV is a statement of the resolutions adopted by the Conference.

A. J. Jaenicke

Secretary,
1919 Ashland Conference.

December 6, 1919.

PART I. RECOMMENDATIONS FOR 1920 SURVEY AND
CONTROL WORK IN CALIFORNIA.

The First Ashland Conference Plan Project.
(Messrs Miller, Hopping, and Jaenicke)

Salient Features.

The Kaweah control project, funds for which were provided by the Sequoia National Park and the Forest Service, is the first and only project under the Ashland Conference Plan. The chief purpose of this investigative project, aside from its value in the protection of the yellow pine and sugar pine timber from future Dendroctonus depredations is in the words of the Plan "to determine the effectiveness of a given percentage and the proper method of application of such a percentage". A detailed description of this project, including a discussion of the control work and the data available up to the close of 1918, is given in the report entitled "Progress Report on the Ashland Conference Plan Projects", copies of which are available in the files of both Bureaus. The control work and the collection of all the data were done under the direct supervision of the Bureau of Entomology and by methods which had its full approval. The outstanding features of this project are:

1. Includes 10,200 acres of yellow pine and sugar pine within the Sequoia National Park and Sequoia National Forest; yellow pine volume 89,500,000 board feet, sugar pine volume 100,000,000 board feet. (The unit was selected because of its pronounced topographic and type barriers, separating it by several miles from other infested pine areas. It is believed that these barriers will greatly reduce the influence of outside infestations).
2. At time of control work the infested volumes were as follows:-
Yellow pine 352,000 board feet,
Sugar pine 396,000 board feet,
3. Control work done in April and May, 1918, at a total cost of \$1600.00.
4. Control work concentrated on 6,200 acres because of the inaccessibility of the remaining 4,000 acres.

5. In the control work, 60% of the then infested yellow pine on the entire unit was treated, and 43% of the then infested sugar pine.
6. On the area on which all of the control work was actually concentrated, 6,200 acres or 60% of the entire area of the unit, the treated infestation was equivalent to 86% of the infested yellow pine and 67% of the infested sugar pine.
7. The results of the control work on the worked area, on the unworked area and the unit as a whole have been carefully followed up by examinations in 1918 and 1919.
8. No entirely satisfactory single check area is available. The progress of uncontrolled infestations outside of the unit but in the same general region have been studied, however, in an effort to obtain an idea of what the infestation on the Kaweah unit would now be in the absence of control work.
9. It is the purpose to continue annual observations on this unit cooperatively by the Bureau of Entomology and the Forest Service, in order to follow up the results of the initial 1918 control work.

Data Available.

The detailed data on this project are available to District 5 and 6 at the Pacific Slope Station at Ashland, Oregon. For the purpose of this report only a brief summary of the data will be attempted.

In the following tables it should be noted that:

1. The yellow pine losses have been separated from the sugar pine losses.
2. The losses for each of these two species have been totalled separately for the worked area, for the unworked area, and for the total unit in order that the relative progress of the infestation on the worked and unworked portion of the unit may be followed out.

3. The "1916 loss", for instance, means all the trees attacked during 1916 with sufficient severity to kill them. In the case of brevicomis in yellow pine, for example, there usually are at least two generations and occasionally a partial third, while monticolae in sugar pine goes thru one full generation and at least a partial second.
4. In estimating the percentage of infested timber treated, consideration is given only the trees infested at the time of control work. Trees attacked during the same year as the control operations but subsequent to these operations are not considered in computing the percentage of infested timber treated.

Yellow pine losses (Board feet)

	On	On	On
	worked area	unworked area	entire unit:
1916	190,000	28,000	218,000
1917	494,000*	116,000	610,000
1918	95,000	15,000	110,000

Sugar pine losses. (Board feet)

	On	On	On
	worked area	unworked area	entire unit:
1916	114,000	7,000***	121,000
1917	215,000**	230,000	445,000
1918	77,000	113,000	190,000

- * 210,000 board feet treated by control work.
 ** 169,000 board feet treated by control work.
 *** Actual loss considerably greater. Exact data lacking.

The more important preliminary conclusions to be drawn from the two preceding tables are:

1. That the control work was done when there was a rise of considerably over 100% in the infestation in the yellow pine and almost 100%

increase in the sugar pine attacks over the preceding year.

2. That in the yellow pine there was a decline of the infestation of 81% in the worked area between 1917 and 1918 or subsequent to the control work.*
3. That in the sugar pine there was a decline of the infestation of 64% in the worked area and 50% in the unworked area between 1917 and 1918 or subsequent to the control work.*
4. That the cause of the decline on the unworked area may be due either to the fact that:
 - a. Control work on the worked area had a tremendous influence on the unworked portion of the unit, or
 - b. Natural forces of control operate just as effectively where no control work is done as on areas where artificial measures are applied.

The insect depredations on a check area of 1,000 acres, known as the Atwell's Mill Check Area and located south of the control project revealed a decrease of 52% in the yellow pine infestation (*D. brevicornis*) between 1917 and 1918, and an increase of 44% in the sugar pine (*D. monticolae*) attacks. The check area, however, is far too small for the purpose, for small check areas like this one frequently do not indicate the general trend of the infestation in the surrounding country.

The work on this unit has forcibly impressed Messrs. Miller, Hopping and Jaenicke with the fact that a satisfactory Area A must be on a very much larger scale than the Kaweah project in order to arrive at any reliable conclusions. Dr. Hopkins emphasizes this in a recent letter.** Definite recommendations for a much more satisfactory area will be found under "Proposed Control Operations on the Sierra National Forest". Further annual examinations of the Kaweah project are strongly recommended, because they will yield data of sufficient value to more than justify the cost of securing them.

*The percentages given are computed from the detailed data and cannot be estimated merely from the two tables given on a previous page.

**The following is a brief from Dr. Hopkins' letter of

November 5 to Mr. Miller: "So called check areas (of limited extent like the Kaweah) do not furnish a reliable basis for measuring the effects of control work. The fact that it is the general habit of *Dendroctonus* beetles to migrate from one center of infestation to another, especially in the second and third year - in the case of *D. frontalis* the first year - of heavy infestation, and that the distance of migration may be 20 miles or more, renders it impossible to draw accurate conclusions on the check (assumed) unit basis. Effort should be directed toward an organized effort to deal with the large infested area or forest, the practical application to be made by the forester and owner on the basis that in general it is safer to rely upon the advice forest entomologist and make a sincere effort to carry it out, judging from results, rather than from opinions, as to its merits."

PROPOSED CONTROL WORK ON THE SIERRA NATIONAL FOREST
(Messrs. Miller, Hopping, and Jaenicke).

1917 Insect Survey.

In the California insect survey of 1917 it was found that the epidemic infestations in the yellow pine and sugar pine of the southern Sierras which were worthy of first attention, in the event of the further extension of insect control work, were located in the Sierra and Sequoia National Forests. In accordance with the findings and recommendations of that survey, it is now proposed to inaugurate control work in 1920 on a large scale on the southern portion of the Sierra National Forest.

The survey work of 1917 revealed the fact that the more valuable pine timber on the Sierra National Forest together with the interlying private holdings and a portion of the Yosemite National Park could be divided into 21 so-called infestation units, totalling 316,000 acres, most of which were in 1917 involved in epidemic insect losses. These 21 units can be grouped into three drainage areas as follows:

Kings River	- 3 units - 50,000 acres.
San Joaquin	- 10 units -139,500 acres.
Fresno & Merced	- 8 units -126,500 acres.
Total	- 21 units 316,000 acres.

The estimated 1917 insect loss in the sugar pine and yellow pine on these 316,000 acres was estimated to be in excess of ten million board feet on the National Forest, National Park, and private timber. The timber stand in all classes of ownership in these units and including yellow pine, sugar pine and Jeffrey pine, is approximately 5,423,500,000 board feet.

A special report* for the situation on the Sierra National Forest was prepared in 1918, and copies of it were sent to the Forester, the Bureau of Entomology, the San Francisco office, and the Supervisor. For more detailed and specific data than is here available on the problem on the Sierra as a whole as well as the San Joaquin drainage (units 22-30 inclusive), this report should be referred to. The two general "California Insect Survey Reports" will throw additional

*Report on the Insect Survey of the Sierra National Forest during the Summer of 1917. A.J. Jaenicke, January, 1918.

light on the matter. For the relative location of the units 22 to 30 inclusive, the blue-print map of the Sierra National Forest which accompanied the survey reports should be consulted.

Proposed Control Area.

After careful consideration of all the conditions surrounding the insect situation both on the Sierra and Sequoia National Forests, it is believed that the San Joaquin drainage of the Sierra National Forest offers the best available large size epidemic fairly isolated area of high timber values on which an insect control project of sufficient magnitude can be carried out.

The following table indicates the units included in this proposed project, their acreage, and the total stand of sugar pine, yellow pine, and Jeffrey pine timber within them:

The San Joaquin Control Project.

Unit No. :	Name of Unit	Acreage :	Pine Stand in M feet.
22	Stevenson Creek	2,240	29,500
22a	Jose Basin	10,400	108,500
23	Big Creek	12,000	166,000
24	Hogue Ranch	18,000	333,000
25	Rock Creek	5,920	108,000
26	Chiquito	13,000	251,000
27	Jackass	5,120	77,000
28	Dalton	23,700	304,500
29	Sand and Whiskey Creek	24,500	670,000
30	Willow Creek	23,000	226,000
Total		138,480	2,273,500

The following ownership of the 2,273,500 M board feet of pine timber on the ten units in the preceding table exists:

National Forest	1,625,000 M
Private Holdings	648,500 M
Total	2,273,500 M

Of the 648,500 M of pine timber in private ownership, 488,000 M are owned by the White and Friant Company which is engaged in an active insect control campaign on its holdings. This Company can be depended upon to satisfactorily cooperate with the Forest Service in this extensive control project. In fact, the inauguration of the San Joaquin control work will do more to satisfy the White and Friant Company in their insistent complaints about the inactivity of the Forest Service in its control work than much more extended work in any other section of the state. Only 161,000 M of pine timber, or less than 8 per cent of the timber on the San Joaquin project is in scattered private ownership, cooperation from which it will probably not be possible to obtain. The ownership and cooperation situations on this project are therefore highly satisfactory.

The San Joaquin drainage was chosen first because far less private ownership is involved and therefore the project is more entirely a Forest Service responsibility than would be the case elsewhere on the Sierra or Sequoia National Forests. In addition the San Joaquin drainage is the most sharply and completely isolated large drainage area within the boundaries of the Sierra National Forest. Moreover, high timber values are involved in this area.

The survey to be made in the early spring of 1920 preliminary to the control operations will include the three Kings River units on the Sierra National Forest totaling 50,000 acres, in addition to the San Joaquin River drainage. The findings of this survey may indicate the feasibility of including the portion of the Kings River drainage on the Sierra National Forest in the 1920 control operations.

Survey Preliminary to Control.

The 1917 survey figures together with data obtained subsequently are merely indicative of the conditions which now exist in the San Joaquin drainage. For the intelligent planning and execution of the control work, and in order that subsequently the result of the control operations may be more easily determined, it is essential that a rather careful insect survey be made in the early spring of 1920.

This survey should be carried out cooperatively between the Bureau of Entomology and the Forest Service. Inasmuch as the period between the time that this survey can be made and the proper beginning of control operations is limited, the Pacific Slope Station plans to put all of

its available personnel on this survey next spring, while the San Francisco office will furnish Mr. Hopping's successor and at least one other man experienced in insect survey work.

For the field expenses of the Bureau of Entomology men on this pre-control survey, it is recommended that an allotment of \$500.00 be placed at the disposal of the District Forester at San Francisco during the present fiscal year by the Forester. Another survey will have to be made of the San Joaquin project area in the fall of 1920 cooperatively by the Bureau of Entomology and the Forest Service. Since the purpose of this fall survey is primarily investigative, the Bureau will pay the field expenses of its own men.

The Control Operations.

In undertaking the San Joaquin project, two purposes are in view, one to put the present epidemic infestation under control, and the second to maintain this control. In brief, this plan involves the inauguration of a permanent insect protective scheme for the San Joaquin project. The 1920 work will be devoted to removing as much of the infestation as the results of the preliminary survey indicate are necessary over as much of the San Joaquin watershed as the administrative and financial limitations make possible. The project is being planned on a scale which is not at all incompatible with the personnel, both administrative and technical, which will be available. Fortunately, a part of the Sierra National Forest personnel already have an intimate knowledge of the administrative work involved in control projects.

The 1920 control operations are to be carried out in the following manner:

First, a portion of the infestation over the entire area will be removed, by the use of large crews, just as has been the case in other Forest Service projects, but it is not expected that in an area as extensive as this it will be possible within the period of the spring work to remove a sufficient percentage of the infestation to establish control. The work will then be continued during the summer and fall of 1920 by the use of small, or what might be termed "flying crews". It is evident therefore that the control operations will cover portions of two fiscal years.

The location of the areas which are to be treated during the first season, the amount of the infestation which is to be removed, and the nature of the working plan for the

entire project will depend upon the data secured by the 1920 spring survey. It is recommended that the administration of the work, at least on the National Forest areas, be handled by the personnel of the Sierra National Forest, perhaps using the individual ranger districts as administrative units.

In addition the results of this work, as they are made evident by the fall examinations of 1920, will determine the amount of work which will be recommended for the season of 1921. It should be kept in mind that the primary purpose of this project is to establish a permanent insect control policy on a definite area, and to perfect an organization capable of handling the work from year to year as the situation may require.

The Forest Service will be responsible for the administrative features of the project, while the Bureau of Entomology will handle the technical phases in accordance with the arrangement outlined in the original Ashland conference plan of January, 1917.

The work subsequent to 1920 will depend upon the findings of the 1920 fall survey and other examinations, but it is quite safe to predict that relatively small annual expenditures will be necessary for the maintenance of control on this project, such restricted operations to be carried on perhaps under the administration of the local forest ranger by the use of a small crew of two or three men during the spring, summer, and fall. It is quite probable that the use of trap trees will be found feasible. In addition, the present indications as a result of Bureau of Entomology investigations that the mere exposure to the sun of the peeled yellow pine bark is sufficient to kill the beetles in all stages, may obviate the necessity of burning the bark during the fire season.

Cost of Control.

The spring survey of 1920 will make possible a rather careful estimate of the cost of the proposed San Joaquin project. The following estimate of cost is therefore tentative although it is based on all the data available at this time.

Cost prior to July 1st, 1920	- \$12,000
Cost subsequent to July 1, 1920-	6,000
Total estimated cost	<u>\$18,000</u>

An allotment of \$18,000 is therefore recommended for this project; \$12,000 to be made available before July 1, 1920

and \$6,000 on July 1, 1920 for the continuance of the work under way. This estimate is exclusive of the \$500 requested for the preliminary survey in the spring of 1920.

The \$18,000 will be expended entirely on National Forest lands in the San Joaquin drainage. It is believed that with the cooperation of the White and Friant Company in controlling the infestation on their own lands that the cooperation of the owners of the scattered 8 per cent of the timber in the project area is not essential in the successful protection of the project. Nevertheless, an effort will be made to secure the financial assistance of these small owners even if the removal of the infestation on their lands will not jeopardize the efficiency of the Forest Service expenditures.

It has already been indicated that the pre-control survey in 1920 may show the feasibility of including the 50,000 acres of Kings River drainage on the Sierra National Forest in the 1920 control work. In the event that the White and Friant Company does not see fit to do effective control work on its holdings in 1920, a rather remote contingency, control work on the 50,000 acres in the Kings River drainage will be highly desirable and the Forest Service project will then include a sufficiently large proportion of this extensive epidemic area so that the efficacy of its work will not be in danger. If the conditions warrant the working of this additional area, an allotment of \$5,500 will probably be needed, divided as follows:

Prior to July 1, 1920	\$3,500
Subsequent to July 1, 1920	\$2,000

As has already been shown the cost in years subsequent to 1920 are entirely dependent on the status of the infestation after the completion of the 1920 work.

Protection and Data to be Secured by Control.

The purpose of the proposed control work on the Sierra National Forest, is the protection of the pine timber of this Forest from further insect depredations, and the demonstration of the most practical and economical methods of securing this protection. The allotment of funds by the Forest Service is recommended primarily with this purpose in view, and the investigative work will be carried on only so far as it does not interfere with the protective purposes of the project.

The area has been located with a view of attacking as a whole all of the infestation within a considerable forest region. The narrow limits of the pine belt in the Southern Sierras render it possible to carry out a project on these lines, especially since the infested areas are definitely limited and the administrative difficulties are therefore much simplified. The methods of control which are to be applied to the general area will be only those which from experience seem to offer the greatest assurance of accomplishing the desired protection at the least expenditure. It is further believed that the extent and boundaries of the area will be such as to insure the results accomplished by the use of these methods against re-infestation from untreated areas. From this standpoint the area is the most comprehensive and extensive insect control project which has as yet been undertaken and it is believed that the owners involved will secure a greater measure of protection for the expenditure than has been possible on the smaller and less favorably located areas which have been treated heretofore.

The investigative value of the project will consist of the opportunity which it offers for a detailed study of the results which can be obtained from the percentage principle of control as applied to a comprehensive infestation of this character. The area will be studied as an enlarged Area A under the Ashland Conference Plan. This will involve a detailed analysis of:

1. The amount of infestation within the control area;
2. The amount of infestation removed by the control work and its ultimate effect;
3. The infestation existing in the region surrounding the control project.

It will probably be found necessary to use more extensive methods in this study than were planned for the original Area A experiment, which was not to exceed 10,000 acres. Enough intensive work however will be carried on to check the results of all extensive work. The reason for resorting to the more extensive methods is due to the size of the area and the limitations in the number of trained men available, for the investigations. However, it is believed that by providing for a Bureau of Entomology field station accessible to the project and by close cooperation with the personnel of the Forest Service organization engaged in the administration of the project, that the investigative data will be of satisfactory accuracy.

Experimental work with new methods of control are not contemplated for the entire area. The conference desires however to propose the testing of new methods, or new applications of standard methods, on limited areas where the timber is largely under the control of the Forest Service. Such methods will be only those which the Bureau of Entomology recommends from results of investigations and preliminary experiments and which the Ashland conference approves as offering reasonable promise of success. The conference is strongly of the opinion that there is a real need for opportunity for investigative work of this kind in addition to the major investigations provided by the Ashland Conference Plan.

KINGS RIVER PROJECT - SEQUOIA NATIONAL FOREST
(Messrs. Miller, Hopping, and Jaenicke)

This control project was recommended in the 1918 Conference report as an "Area B" experiment, the purpose of which in the words of the Ashland Conference Plan is:

"To determine the extent of a sphere of influence, or what constitutes an infestation unit best suited for control operations".

For this work an allotment of \$1,800 was made, but in the early spring of 1919 it became apparent that there was a strong possibility of the inclusion of Kings River Canyon in the Sequoia National Park. This impending transfer of the area from the jurisdiction of the Forest Service to the National Park Service, and the difficulties in the successful completion of the proposed control and experimental work which this change might involve, led to the postponement of the project. Messrs. Miller and Hopping devoted a part of the field season of 1919 to the location of a suitable "Area B" on some other portion of the Sequoia National Forest, or on the Santa Barbara National Forest, but no area as well fitted for the experiment as Kings River Canyon was found.

A distinct advantage of the Kings River area is its accessibility to the proposed control work in the San Joaquin drainage of the Sierra National Forest. The fact too that accurate data are available on the progress of the infestation in the Canyon during the past several years makes the area still more desirable from the investigative standpoint. The losses of pine timber in the Canyon have been great year after year and have reached the point where they are a decided detriment to the high recreational value of the Canyon. The number of visitors to the Canyon is constantly increasing, and the annual depletion of already open stand of timber is the subject of much concern among the tourists.

If it seems probable that the Forest Service is to retain jurisdiction of this area, the Conference wishes to recommend the Kings River area for control work during the spring of 1920 under the same plan and procedure as described in the 1918 Ashland Conference report. For this control work an allotment of \$1,800 will be needed, divided as follows:

\$1,200 for work in spring of 1920 prior to July 1.
\$ 600 for work immediately subsequent to July 1.

PROPOSED COOPERATIVE INTENSIVE INSECT SURVEYS
IN CALIFORNIA FOR 1920

(Messrs. Miller, Hopping, and Jaenicke)

Santa Barbara National Forest.

During the latter part of May and early June, and again in September, 1919, Messrs. Miller and Hopping visited this Forest to determine the feasibility of using some of the exceedingly isolated islands of yellow and Jeffrey pine stands for investigative work. Only a few of these so-called islands were actually studied, but the field work was sufficient to convince them that from the investigative standpoint, they had two possibilities:

1. Annual examinations (preferably in the fall) to follow the progress of the uncontrolled infestations on Zaca Pinery (1000 acres), Figueroa Pinery (1000 acres), and East Pinery (320 acres). Specific data are already available on the 1918 and 1919 losses on these three pineries, and some definite and useful information on infestation cycles can be secured by annual field examinations of only four or five days duration by either a Bureau of Entomology or a Forest Service official, or both. The annual examination is recommended for 1920. No Forest Service allotment recommended.
2. The inauguration of control work on one or more of the isolated islands to serve several investigative purposes. Because of the immediate necessity of concentration of all possible attention on the Sierra National Forest during 1920, it is believed desirable to defer control work for a year or two at least.

Kaweah Project.

(Ashland Conference Plan Control Area on Sequoia National Park and Sequoia National Forest).

The necessary 1920 annual examination of this area will be made cooperatively by the Bureau of Entomology and the San Francisco office of the Forest Service in May or June, 1920. No special Forest Service allotment recommended.

Sequoia National Park.

Intensive surveys, experimental work of various kinds, and a limited amount of insect control work will be undertaken in 1920 by the Pacific Slope Station of the Bureau of Entomology. Mr. Albert Wagner's (of the Pacific Slope Station) data obtained during the past two seasons on the Sequoia National Park on the efficacy of trap trees in yellow pine infestations, the feasibility of killing brevicomis larvae by exposing the bark to the sun for an extended period instead of burning it, the efficacy of control work done during the summer months by a one or two man crew, the use of powder in felling infested trees, life history data on brevicomis and monticolae, etc, have a direct bearing on insect control problems and the continuation of his work on the Sequoia Park is a real necessity. Handled entirely by Bureau of Entomology with Bureau and Park Service funds.

Modoc National Forest.

The eastern division of the Modoc National Forest contains in excess of 300,000 acres of quite valuable pine timber. In the northern portion of this Division there exists an infestation in good yellow pine about 35,000 acres in extent the timber on which has for several years, been involved in epidemic insect losses. Between 1914 and 1917 there was a gradual rise in the infestation, while in 1918 the increase over 1917 was unusually great. The losses still further increased in 1919. During the past summer, some of the carefully cruised sections showed a present annual loss of 91 trees over 30 inches in diameter per section. In addition there was a heavy loss by D. monticolae in yellow pine between the diameters of 12 and 18 inches, and ips confusus depredations in yellow pine under 12 inches in diameter. In brief, the situation as revealed by Mr. Hopping's field work is one worthy of serious consideration.

Already rough data on the status of the infestation for the past four years are available, and there is needed now a more careful survey of the 35,000 acre project area preliminary to definite recommendations as to the proper protective measures. Even if control measures are deemed desirable, and it is quite certain that they are, they cannot be undertaken until 1921 in view of the administrative demands of the proposed extensive 1920 Sierra control work. However, in order that intelligent interpretation of the effect of any control work, which may subsequently be recommended may be rendered easier and more certain, a rather extensive survey is recommended for June, 1920.

The project offers possibilities both for doing effective control work and for the securing of data especially applicable to insect control projects in yellow pine in southern Oregon and northern California. In view of the fact that Mr. Hopping's successor in District Five will have to spend a great deal of his time in the late spring and early summer on the proposed Sierra project, and in view of the fact that the Modoc problem may in reality be a Fremont (D-6) - Modoc situation, it is recommended that the survey be done cooperatively by Forest Examiner Jaenicke of District Six and the Pacific Slope Station. This is the only participation of Mr. Jaenicke in California work recommended for the 1920 field season. The Pacific Slope Station will furnish Mr. J. E. Patterson for the survey. The work will require a maximum of three weeks of field work on the part of Messrs. Jaenicke and Patterson in the month of June, 1920. The Bureau of Entomology will pay Mr. Patterson's salary, and it is recommended that the Forest Service pay his expenses for this National Forest work. Mr. Jaenicke has already indicated that he can fit in this work with his field work planned on the Fremont National Forest which is contiguous to the Modoc.

It is recommended that an allotment of \$200 during the present fiscal year be made to the District Forester at San Francisco for the field expenses of Messrs. Jaenicke and Patterson on this work. In the event that this allotment can not be made till July 1, 1920, the field work can still be undertaken but at the disadvantage resulting in interference with other field plans now tentatively arranged.

Sierra National Forest.

The survey work in the spring of 1920 preliminary to control work on the Sierra National Forest, to be carried out cooperatively between the Bureau of Entomology and the Forest Service, is discussed at length in the section entitled "Proposed Control Work on the Sierra National Forest". As indicated in that Section, the allotment recommended for the assistance in the field work by the Bureau of Entomology men on the survey work and during the actual control operations is \$500, all to be made available during the present fiscal year. At least three men will be furnished by the Bureau. The Bureau will pay all the salaries of its men while on this work. It is not believed that any special allotment for the expenses of Forest Service men will be necessary.

During the fall of 1920, another cruise of the project will have to be made cooperatively by the Bureau of Entomology and the Forest Service. Inasmuch as the purpose of this fall cruise is strictly investigative, the Bureau will entirely finance its share of that work.

Summary of Allotment Recommendations.

The allotments necessary to carry out the survey work and the control operations recommended in the preceding sections of this report are as follows. The decision as to the allotments for the present fiscal year (1920) should be rendered as soon as possible in order to make possible a careful planning of both the surveys and the control work sufficiently in advance. The funds for the fiscal year 1921 include only those which are to be spent immediately subsequent to July 1, 1920, and therefore, if the allotments are approved, the money should be available on that date.

I. <u>Sierra National Forest</u>	<u>F.Y. 1920</u>	<u>F.Y. 1921</u>
Preliminary survey (field expenses of Bureau representatives) \$ 500		
Control work, San Joaquin drainage 12,000		\$6,000
Control work, Kings River drainage (Tentative) 3,500		2,000
II. <u>Sequoia National Forest - Kings River Canyon project (Area B experiment)</u> 1,200		500
III. <u>Modoc National Forest - survey of infestation.</u> 200		
Total	\$17,400	\$8,500
Total for calendar year 1920		\$26,000

PART II. SUMMARY OF PAPERS PRESENTED BY PACIFIC

SLOPE AND COEUR D'ALENE STATIONS.

Insect Survey Methods.
(Discussion led by J. M. Miller)

The Conference went on record as approving the method of insect surveys* as adopted in the California insect survey in 1917 with full cognizance of the limitations in the accuracy of such extensive insect surveys. The method is advocated for general use where the needs of the situation require only rough estimates of insect losses on large areas or where restricted funds or small personnel make more intensive methods impossible. This method consists in brief, of topographic viewing of the area, supplemented by intensive cruises on sample plots from time to time which furnish the necessary data for the proper interpretation and significance of the counts obtained in the extensive cruises. This field work should result in:

1. A base map showing the area covered, routes of travel, location of all insect killed trees actually seen, location of sample plots and the division of the area into units of infestation or control units.
2. A count of all fading or sorrel and red topped trees seen on the area in the course of the topographic viewing of the extensive work.
3. Detailed maps of the check areas or sample plots, together with full data on the individual insect-killed trees found on them. (These data are subsequently used in the office compilation for the determination of the percentage of trees actually seen in the extensive work, average volumes, etc.).

// The color phase of the foliage of the infested and abandoned insect killed trees on survey areas is important in separating the losses by calendar years. Great difficulty has always been experienced in interpretation of the color phases by different estimators, due to individual differences

*A detailed description of this method may be found in "General Report of the 1917 California Insect Survey". November, 1917. Pages 17-20.

in color perception. For instance, what one estimator may call sorrel another may regard as red. In order to obviate these discrepancies the Conference agreed to adhere to the four primary color phases outlined by Dr. Hopkins in Bulletin 83 of the Bureau of Entomology and apply them to the Rocky Mountain and Pacific Slope Station for general use in survey work.

- Stage I. Trees just beginning to fade from the normal green. - "Fading tops", Bulletin 83.
- Stage II. Faded trees which have a full complement of needles which may be either yellow, sorrel, or red in color and from which all trace of green coloration has disappeared. - "Sorrel tops", Bulletin 83.
- Stage III. Trees transitional between those which have full complement of needles, (Stage II), and those which have lost most of their foliage, (Stage IV). - "Red tops", Bulletin 83.
- Stage IV. Black topped trees which have lost their needles. - "Black tops", Bulletin 83.
- Stage V. Ghost trees, or trees which have lost their bark. (To be omitted from insect data forms).

Experience during the past two field seasons subsequent to the 1917 California insect survey has suggested a number of changes in the original $3\frac{1}{2} \times 5\frac{1}{2}$ inch perforated tree data forms used so largely on insect surveys and formerly printed in books of 100. The revised form agreed upon is the following:

TRUNK DATA -- INSECT SURVEYS.

No. tree.....
 Name of plot.....
 Sec..... Twp..... R.....
 Tree species..... Foliage stage.
 D.B.H..... Stage I.....
 No. 16 foot logs.... Stage II.....
 Infested..... Stage III.....
 Abandoned..... Stage IV.....
 Primary Insect.....
 Parent adults.....
 Eggs.....
 Larvae.....
 Pupae.....
 New adults.....
 Observer.....
 Date..... 19.....
 Miscellaneous data.....

THE INFESTATION UNIT.
(J. M. Miller)

The determination of the character and extent of the infestation unit is a problem of paramount importance in the successful application of artificial control measures. By an infestation unit is meant an area of such size and protected by such effective barriers that the amount of infestation in it will not be materially increased by beetles flying into it, nor materially decreased by the flight of beetles which may leave to go to outside timber stands. The same thing must be applicable to the migration of the natural enemies of the beetles into or out of the unit. Effective boundaries and adequate size characterize the true infestation unit. If the infested area has no effective boundaries, then the infestation unit (and we may call the infestation unit the ideal insect control unit also) must cover a sufficiently large area so that the amount of infestation which may drift into it from its borders, or even out of it, will not materially increase or decrease the total volume of the infestation within the unit.

As a matter of fact, it is exceedingly rare to find any timbered areas which are so completely isolated and of such size as to constitute ideal infestation units, and yet it is of consequence to understand what the ideal conditions are in order that an effort may be made to approach the ideal as closely as possible in working out an insect control program.

In the last analysis, the infestation unit is dependent upon the flight habits of *Dendroctonus* beetles. Two extreme opinions are prevalent, one that they may fly only a few hundred yards, and the other that they may fly many miles.

Although no absolutely conclusive data are available the preponderance of the evidence indicates that under certain conditions the beetles may fly a considerable distance and that quite frequently this flight may amount to several miles. The more recent bases for these conclusions are from careful observations made in the Yosemite and the Sequoia National Parks. The data obtained on the Yosemite as a result of two years of control work by Mr. J. E. Patterson is especially significant although not final. The problem is of such importance in the proper application of control measures that attention will continue to be paid to it in Conference Plan projects. In the meantime, it seems certain that the more extensive the areas on which control measures are carried out simultaneously in an infested region, the less jeopardy there will be from partial nullification of the work as a result of the influx of beetles

from the outside. This last matter Dr. A. D. Hopkins has continued to emphasize year after year ever since the inauguration of control measures in the West in urging that only large scale operations can ordinarily be successful where the insect depredations are widespread.

OBSERVATIONS ON THE FLUCTUATIONS -

D. brevicornis Epidemics. (J. M. Miller)

An undisturbed epidemic infestation in yellow pine on what is known as the Rogue River Area in southern Oregon, covering about 48,000 acres has been under careful observation by the Pacific Slope Station since 1915. Already this intensive study has yielded much data of practical application in control work. In addition, three years data on insect losses in 255,000 acres of yellow pine timber on the so-called Klamath River area and four years of data on the Applegate area of 150,000 acres are available, which serve to bear out and strengthen the preliminary conclusions which can already be safely drawn from the Rogue River situation. It is believed that these deductions are generally applicable to D. brevicornis infestations in yellow pine in Oregon and California.

1. That the losses by this insect are subject to great fluctuations from year to year. For instance, the Rogue River area losses in board feet are as follows:

1914	-	346,000
1915	-	1,615,000
1916	-	1,383,000
1917	-	608,000
1918	-	910,000 (approx.)

On the Klamath River area the losses show a similar fluctuation from year to year:

1914	-	762,000
1915	-	2,637,000
1916	-	881,000
1917	-	590,000

2. In the various units in which the Rogue River, Klamath River, and Applegate areas are divided, the increase and decrease in the annual losses progressed with some similarity. This indicates that the factors which influence the rise and decline of epidemics are not confined to small local centers or watersheds but operate simultaneously over considerable areas.
3. The annual loss may run as high as $5\frac{1}{2}$ percent of the stand at the height of the epidemic, and does not exceed $\frac{1}{2}$ of one per cent of the stand during the low point.

4. Fire seems to have the effect of suddenly increasing insect losses many fold on the burned area and drawing it away from surrounding areas, at least in the one case under observation.* However, this heavy infestation lasted but one year, the year following the fire. It was also found that the broods of the beetles in the fire-scorched trees failed to develop much beyond the original number that attacked the trees. So the fire did not contribute to an increase of the beetles in the general area around the burn, or to the starting or extension of an epidemic of the beetles.

*This is the Mistletoe unit of 8000 acres in the Rogue River Area. During the four years previous to the fire, the insect loss on the unit amounted to 497,000 board feet. A fire burned over 800 acres of the unit on October 31, 1917. The fire loss was only 17,000 board feet while the insect loss on the burn jumped over 1000 per cent in 1918 over that which had occurred in 1917 while in the remaining 7,000 acres of the unit there was no increase in 1918 over 1917 insect losses.

INSECT DEPREDATIONS IN THE WHITE PINE
STANDS OF NORTHERN IDAHO.
(James C. Evenden)*

The following is a brief summary of a paper presented at the Conference by Mr. Evenden of the Coeur d'Alene Station:

For almost a decade the insect losses in the white pine stands of Montana and Idaho, and more recently the more limited stands of white pine in Oregon and Washington, have been recognized to be worthy of careful attention in the management and protection of forests containing this valuable tree.

The recent establishment of the Coeur d'Alene field station for the careful study of insect depredations in this species fills a need which has long been felt by the Forest Service personnel in the white pine region of Montana and Idaho. The phase of the situation which seems to demand first attention is the nature of the epidemic cycle of these D. Monticolae attacks and the factors contributing to the decrease and increase of the insect losses. For the first intensive study of this matter the Coeur d'Alene National Forest has set aside an area on the headwaters of Independence Creek which contains, exclusive of other species, four million feet of white pine. In the past five years at least 10 per cent of the white pine on this area has been killed by D. monticolae. At present the infestation on this watershed is at a low ebb, a condition which is applicable to the Coeur d'Alene National Forest as a whole. The conclusions ultimately to be reached as a result of this intensive study will have, it is believed, a wide application throughout the white pine forests of Districts One and Six.

Thus far most of the information available on insect losses in white pine, particularly with reference to their fluctuating nature, and the severity which the losses may occasionally reach, is confined to the Coeur d'Alene National Forest. Forest Service records indicated that during the period 1906-1911 inclusive that the insect damage on this Forest was at a low stage. In 1913, however, there was a marked increase

*Upon Mr. Evenden's return to the Bureau of Entomology from overseas service in the army, he was placed in charge of a new Forest Insect Field Station at Coeur d'Alene, Idaho. For the present, this Station will devote most of its attention to the white pine problem of northern Idaho and the yellow pine situation in western Oregon and Washington.

and a survey made by Forest Examiner Malven indicated that the white pine losses for that year were in excess of two and a half million feet for the Coeur d'Alene National Forest alone.

In 1915, Mr. Evenden of the Bureau of Entomology, made an insect survey of the Forest and found the insect losses in the white pine to be as follows:

1913	2,600,000 bd feet ^a
1914	1,609,000 bd feet.
1915	707,000 bd feet.

The gradual decline during the period 1913-1915, inclusive, has not been followed by any recurrence of the epidemic in the years 1916-1919, inclusive. It is interesting to note that the insect loss for 1914 and 1915 was over 2,316,000 board feet while the fire loss in white pine according to Forest Service compilations, was only 944,000 board feet for the same two year period.

In the spring of 1914 control operations were undertaken on three areas on the Coeur d'Alene National Forest, namely Eagle Creek, Lieberg Creek, and the Forks. Mr. Evenden examined all three of these project areas the following summer and found that there had been a very decided decrease in the infestation. However, there was also a marked decrease in the depredations in white pine stands throughout the entire Forest varying from 60 per cent to 100 per cent.

The blue staining of the sapwood of insect-infested and insect-abandoned white pine is a matter of consequence in the possible salvaging of the timber killed by bark-beetles. It is found, in addition, that timber attacked by bark-beetles subsequent to felling is also especially susceptible to blue-staining of the sapwood. Dr. James Weir, Forest Pathologist at Spokane for District One, is of the opinion that the fungus does not weaken the sapwood until possible in its very advanced stage. The staining of the sapwood renders it unfit for finishing lumber and bars it from the higher grades.

The cooperative relations now in effect between the Coeur d'Alene Station and the Forest Service organization of District One are highly satisfactory. Because of the growing importance of the white pine insect problem in Oregon and Washington, District Six of the Forest Service is also taking an active interest in the work of this Field Station. Eventually, when it is found possible to enlarge the investigative program of the Station to include a study of the yellow pine problem of the eastern portions of District Six and all of District One, it will be found desirable to maintain even closer relations with the Portland office of the Forest Service.

^aMalven's survey data.

THE NEEDLEMINER ON THE YOSEMITE NATIONAL PARK.
(J. E. Patterson)

During the first day of the session, November 18, it was found impracticable to take up the discussion of the regular insect control discussion of the program as the matter of selecting a secretary was delayed until Mr. Jaenicke's arrival from Montana. Mr. J. E. Patterson of the Pacific Slope Station, utilized this time by giving an account of the life history of the lodgepole pine needleminer (*Recurvaria milleri*). The discussion, which Mr. Patterson illustrated with an unusually fine set of photographs, microscopic slides, and graphs, showing the various stages of development of the insect, covers seven years of field records, 1912-1919. During the past two seasons Mr. Patterson has finally determined the complicated and unique life cycle of this insect. This represents one of the most thorough and painstaking pieces of original work which it has been the privilege of the conference to study. It is the plan of the Pacific Slope Station to present these data to the Bureau of Entomology for approval and publication in the near future. It was the sense of the conference that there should be an opportunity for the publication of Mr. Patterson's work either in a Department publication or an entomological journal, in order that the data may be made available to entomologists and foresters. In fairness to the author and in order to obviate a possible duplication of effort by workers outside the Bureau of Entomology, the report deserves publicity.

PART III. SUMMARY OF PAPERS PRESENTED BY
FOREST SERVICE REPRESENTATIVES.

The 1919 Situation on the National Forests of California.
(Ralph Hopping, with comments by J. M. Miller)

As a basis for this paper Mr. Hopping used his 1919 annual report, a copy of which was sent the Forester in November, 1919. During the past six or seven years Mr. Hopping has been systematically and carefully collecting data on both uncontrolled and worked infestations on the National Forests of California. These data have been gathered by reliable methods and in most instances by very intensive work. The accuracy of his data is unquestioned, but it is in the interpretation of these data and the conclusions drawn from these interpretations which permit of honest and serious differences of opinion. The Conference, as a whole, did not go definitely on record as to its attitude on the moot questions raised by some of Mr. Hopping's conclusions, and it is not within the scope of this summary to bring out in any detail the basis of these differences.

The following conclusions presented by Mr. Hopping have the support of the Conference participants with a qualification of the first conclusion.

1. In lumbering and milling operations, the burning of slash and cull logs in the woods before or while infested, the dumping of saw logs into a pond, and the railroading of infested logs out of the timber region, all have a beneficial effect in reducing infestation. ("It is not believed that these beneficial effects are sufficiently great in numerous enough cases to warrant rigid provisions in timber sale contracts on National Forests. Neither has it been definitely established that undisposed slash and cull logs start infestations sufficiently serious or frequent to always warrant the cost of special measures of disposal. This is a problem on which careful investigations are lacking and are urgently needed". Messrs. Miller and Jaenicke.)
2. That epidemic infestations in pine timber stands, (D. monticolae in sugar pine and D. brevicornis in yellow pine), are subject to wide annual fluctuations and that the data thus far obtained tentatively indicate the occurrence of cycles.

3. That the carrying out of a definite and permanent insect control program is essential on those areas from which epidemic infestations have been removed, and in addition on those pine areas on which insect losses are not now as severe as those on which control work has hitherto been confined.
4. That control operations simultaneously executed on large areas are more apt to result in a successful reduction of insect losses than an equal amount of work done on scattered areas.
5. That full advantage should be taken of the status of an infestation in considering the feasibility of control work at any given time. In other words, it is good economy to concentrate work on those areas where the epidemic losses are temporarily low rather than delay control operations until the epidemic again reaches a high stage.
6. That available data indicate that fires cause great concentration of insect infestation to burned pine stands, but that these increases are of exceedingly short duration.
7. That the insect losses in the pine timber of the National Forests of California warrant the allotment of a much larger sum annually than has been available up to this time.

In the light of data secured during several years of investigation by the Pacific Slope Station at Ashland, Oregon, in the pine stands of Oregon and California, and in view of the susceptibility of Mr. Hopping's data to important differences in interpretation, the following conclusions could not be unreservedly accepted by the Conference as a whole. A comment by Mr. Miller on the position of the Bureau of Entomology on conclusion one and two follows this enumeration.

1. "That the percentage of re-infestation after one year's work is in exact proportion to the amount of infestation not worked".
2. "That two years of thorough control work give apparently much better results than one year of control work; that after three or four years'

work the infestation comes back more slowly than after one or even two years' work; that on all projects on which data have been collected, the infestation has increased after the control work has ceased in proportion to the amount of control work".

5. "Epidemic infestations in virgin timber increase from the minimum through a period of four years. After reaching the maximum the decrease begins rapidly and covers a period of three or four years". (Note: The data secured by the Pacific Slope Station on this matter is applicable only to D. brevicornis attacks in yellow pine, and the few instances in which a definite eight year cycle have been observed are also accompanied by observations on other yellow pine areas which show considerable deviation from the eight year period. The data thus far indicate that no very definite regularity in the cycles can be expected, and especially that an epidemic may remain at a low ebb for a considerable number of years before again increasing. The Ashland Station data do show, however, just as Mr. Hopping's data do, that the brevicornis decreases are sudden and rapid". Messrs. Miller and Jaenicke).

"The following informal and unofficial explanation of the insect control principles and their application, as advocated by the Bureau of Entomology, seems to be needed, not only by way of comment on Mr. Hopping's conclusions, but to clear up any possible uncertainty in the mind of the readers of this 1919 Ashland Conference report as to the attitude of the Pacific Slope Station on these matters. The exposition was written by Mr. J. M. Miller of the Pacific Slope Station at Ashland.

The differences between Mr. Hopping's interpretation and my own of the same data are believed to result largely from our difference of opinion on what constitutes an infestation unit. In many respects, however, Hopping and I are in entire accord. In fact, I believe that the points of agreement greatly outweigh the differences. Furthermore, both of us are willing to accept the results of careful investigations on the points under contention.

"Conclusion one and two on page 35, apparently question the control procedure advocated by the Bureau of Entomology, a procedure which my own field work convinces me is the only feasible basis upon which to attack our control problems. The work of Pacific Slope Station however, represents but a small part of the data upon which this policy is based, for many years of field work by other workers of the Branch of Forest Insects in other regions have contributed to the formulation of it in its present form. I believe that the main differences between the views held by Mr. Hopping and the Bureau of Entomology involved in conclusion one and two are as follows:

Conclusion One. (Page 35)

The Bureau holds that the percentage of re-infestation may depend as much upon the natural factors of control which are operative, as upon the artificial measures. Were it not for these natural agencies of control it is evident that epidemics in the past would have continued unchecked until there would be no pine forests today. There are many epidemics which are known to have completely subsided although no infestation at all was removed by artificial control measures. In the second place, the amount of reinfestation depends on the influence of outside areas; namely, the infestation that may come in from, or be drawn out to, other centers of attraction. Just how far this influence extends, or how dependable a factor it is, can only be determined by further investigations. It is evident however, that it is of paramount importance in outlining control areas. Our data indicate that no control project has as yet been undertaken in California which is of sufficient extent, or protected by barriers which are adequate enough, to eliminate this outside influence. Conclusions drawn from control work on such incomplete units are patently invalid for general application.

Conclusion Two. (Page 35)

This statement is also at variance with the position of the Bureau for the reasons just stated. If this statement is accepted as conclusive, it would be logical to work repeatedly the same limited control area by intensive methods, regardless of conditions outside the area. This is at variance with the Bureau's position on the proper treatment of epidemics, but agrees to some extent on its method of treating endemics. The Bureau's policy of fighting epidemics is to remove just enough of the infestation to break the epidemic and assist natural

agencies in bringing about a rapid reduction of the timber losses. It is not believed that funds can be expended to any advantage on the control of an infestation which is already on the rapid decline. The desirability of second year work depends entirely upon the proportion of the control unit which was covered by the initial work, and the status of the infestation at the time second year work is under consideration. If the work of one season does not bring about the decline of an infestation on a comprehensive unit, then it should be continued the second year. However the continuance of control work, year after year, on an area which forms only a part of a large infestation, will never result in adequate protection to either the control area or the surrounding forest. Such control work is believed to be largely a waste of money. The control work of one season on a limited area may result in a temporary check to the infestation on it, but the efforts of the following year should be directed to the reduction of the epidemics which adjoin the control area or which exist anywhere within the same general forested region. It is not believed that this method of procedure has ever been carried out on any of the Forest Service projects, and it is to this failure to recognize sufficiently comprehensive infestation units which accounts for the return of the infestation in control areas situated like the Chiquito and Stevenson Creek projects. Personally, I do not believe that the failure to follow the Bureau's accepted procedure on the National Forests of California was due to antagonism. The lack of money to carry out the work on a sufficiently large scale, and misunderstanding of the Bureau's recommendations are responsible for the procedure actually followed.

Mr. Hopping believes that some control work each season on the same area is necessary in the treatment of endemic infestations as a measure to prevent their increase to epidemics, and to this the Pacific Slope Station agrees that it is maintained that the treatment of endemics is desirable only when a permanent insect control policy is maintained over extensive and comprehensive infestation units. Even in the early publications by Dr. Hopkins, the Bureau advocated the removal of incipient epidemics as the situation may require each year, both by certain methods of forest management and the direct treatment of infested trees. This general policy has been outlined and specific methods suggested in Bulletin 83 of the Bureau of Entomology (page 32) and in other publications of the Bureau, but to my knowledge the policy has never been adopted on National Forests. This

is largely attributable to lack of close cooperation between the two Bureaus in the formulation of an insect control policy for the National Forests. The 1917 Ashland Conference Plan has furnished a very satisfactory basis for carrying out such cooperation, and as a result it has become possible to agree on recommending the adoption and test of this policy for the Sierra National Forest.

Briefly, the Bureau's policy is based upon the fact that the most apparent loss of timber from insect depredations on our western forests results from recurring epidemics which are usually of temporary duration. The Bureau advocates the reduction of these epidemics wherever they occur as quickly as possible, recognizing and taking full advantage of the natural controlling factors in bringing about this result. The maintenance of this control, when once established, necessitates the adoption of a permanent policy, intelligent supervision, and reliance upon the best technical advice. The Bureau of Entomology stands ready to amend its present methods of control if adequate tests show that they are at fault. Careful investigations are now under way in an effort to improve, if possible, methods now in use. It is not considered, however, that the tests which have been made thus far do not warrant the conclusion that the methods now employed are ineffective. A satisfactory test of the efficacy of these methods involves their application on a sufficiently large area, under proper supervision, and in the right spirit."

THE 1919 SITUATION ON THE NATIONAL FORESTS
OF OREGON AND WASHINGTON.
(A. J. Jaenicke)

No insect control projects have been undertaken by the Forest Service in Oregon and Washington since the completion of the Whitman and Ochoco projects several years ago, primarily because nowhere on the National Forests of these two states has there arisen, until recently, infestation sufficiently menacing to valuable timber stands to warrant protective measures. With the cooperation of the rangers, supplemented by my field work on the more important areas, together with the data made available by the Pacific Slope Station on the southern Oregon infestation, it has been possible for the District office at Portland to keep informed from time to time on the severity and distribution of the insect losses on the National Forests in the District.

To my mind the more important insect problems which are involved in the adequate protection of the forests of Oregon and Washington against insect depredations include:

1. Losses in virgin yellow pine stands by D. brevicornis.
2. Losses in mixed lodgepole and yellow pine stands by D. monticolae.
3. Deterioration of fire-killed Douglas fir and hemlock by borer attacks.
4. The high mortality due to D. Monticolae in the limited white pine stands of the District before the maturity of the trees. (White pine might more safely be planted on a much larger scale in the District were it not for the apparent susceptibility of the tree to these losses by Dendroctonus.)
5. The serious depletion the reserve stand left on yellow pine sale areas. This problem must be met promptly. The underlying causes for the unusual activity of D. brevicornis on these cut over areas are not entirely understood. Careful study of the situation is contemplated with the cooperation of the Ashland Station during the coming field season. In this connection the entomological aspect of brush disposal needs attention badly. The relation, if

any, which exists between undisposed brush and subsequent insect attacks to standing timber is a matter which is constantly coming up, not only in sale administration, but in all operations which require cutting of timber such as road and trail construction, clearing of railroad rights of way, etc.

6. The defoliations in Sitka spruce, Douglas fir, and hemlock. In Oregon and Washington these defoliations have recently resulted in actual timber losses, but for the most part outside of the National Forests. The continuation of the study by the Pacific Slope Station of the entomological questions involved in these depredations is urgently needed. The work already done by the Station on this problem has proven of real value.

The investigative work now being carried on by the Pacific Slope Station with its limited personnel and funds has an important bearing on the ultimate satisfactory solution of the District Six problems. The work which the Station has done cooperatively with the Forest Service in the Southern Sierras of California, and independently in the Rogue River, Applegate, and Klamath River watersheds of Oregon and California, have already yielded results which will be of specific practical value when District Six is ready, as it soon must be, to outline and put into effect an adequate control policy.

It is my hope that I shall be permitted to take a sufficiently active part in the proposed 1920 enlargement of the insect control policy on the National Forests of California to enable me to intelligently apply the California results to the yellow pine problem of Oregon and Washington.

I am convinced that an important responsibility which the insect control men in the Forest Service organization should try to meet far more satisfactorily in the future than has been the case in the past, is the spread of information, among administrative and investigative men in our organization, and foresters and lumbermen in general, on the character and significance of the insect control problem. The various lumber journals and the Journal of Forestry have always expressed their willingness to accept material for publication on the insect problem. Such phases of the problem which concern forest administration and forest management are entirely within the proper realm of the Forest Service writer. I believe too

that approved co-authorship with men in the Bureau of Entomology even in articles of general informative value is decidedly to be recommended.

For more detailed information on District Six insect problems the reader is referred to the 1919 annual report which will be in the hands of the Forester in January, 1920.

THE 1919 SITUATION ON THE NATIONAL FORESTS OF COLORADO.
(Wallace Pearce)

The following data have been taken from a paper prepared by Wallace Pearce, Forest Examiner in the District office at Denver, and in charge of insect control work in District Two. Mr. Pearce's attendance was a distinct asset to the Conference, and his participation in the next annual meeting is urged as being highly desirable.

Extensive insect reconnaissance in the San Juan, Durango, and Montezuma National Forests indicates that many of the yellow pine stands in these forests are infested by *Dendroctonus* species, particularly the Black Hills beetle, to an extent which warrants control work on a large scale. In many cases the annual insect loss is far in excess of what is replaced by growth, and as a consequence a gradual depletion of the mature and immature timber is taking place. On a part of the Montezuma, for instance, the annual loss due to insects alone approximate 4 per cent. On Deep Creek on the Durango, 60 per cent of the original stand of yellow pine on over 5,000 acres has already been killed by an infestation of long standing, while in 1918 alone the loss amounted to 3 per cent. In the 1917 Pine River project on the Durango the infested volume actually treated amounted to 2 per cent of the stand on the control area. On the 1919 Bridge Creek project on the San Juan National Forest the infested timber treated was in excess of 5 per cent of the volume on the 1,400 acres in the project area. These figures are indicative of the seriousness of the situation on a considerable portion of the yellow pine belt in southern Colorado.

The more salient features of the larger projects recently undertaken in Colorado are as follows:

Durango National Forest.

Pine River Project:

Area covered - 8,400 acres
Stand of timber protected - 100,000,000 bd. feet.
Cost of protection - \$3,500 (approx)
Cost per M for timber treated - \$6.43
Total board feet volume treated - 550,000

Deep Creek Project - 1919:

Area covered - 5,400 acres
Stand of timber protected - 17,000,000 bd. feet
Cost of protection - \$1,300 (Approx)
Cost per M for timber treated - \$6.77
Total board foot volume treated - 190,000

San Juan National Forest.

Bridge Creek Project - 1919:

Area covered - 1,400 acres
Stand of timber protected - 3,000,000 bd. feet
Cost of protection - \$1,200 (approx)
Cost per M for timber treated - \$7.36
Total board foot volume treated - 165,000

The relatively higher average cost per thousand board feet of treated timber on these projects as compared with most of the California projects is largely due to the lower average volume of the individual infested trees, the higher cost of labor and its generally unsatisfactory nature, and the fact that much of the overhead expense was charged to the projects.

In control work it was found that it was necessary to peel the bark from trees below 12 inches in diameter, inasmuch as the charring of the bark was insufficient to kill the insects. During the latter part of the control work great care had to be exercised in the burning work because of the fire danger. The precautionary measures against spread of fire also had a tendency to increase the cost of the control work.

The uninfested tops of the felled trees were left unburned in the 1917 Pine River project. In 1919 an examination showed that these tops had been subsequently infested by the Black Hills beetle, and that in time there was a full emergence of the beetles. The same examination revealed infested timber near these undisposed tops. In the 1919 control work these tops, whether infested or not were lopped, the brush piled around them, and the mass burned. The 1917 Pine River project was confined to narrow areas along the river bottoms where most of the infestation was concentrated because of the lack of funds. An examination in 1918 revealed new infestation in these bottoms which apparently had come in from the adjacent unworked areas. This situation was entirely taken care of by the 1919 control work.

A second project on the Durango was carried out in 1917 known as the Electra Lake area. In 1917, 250 trees were cut and burned on half a section of yellow pine. In October of that year only 7 infested trees appeared, and but 20 trees in July, 1918.

The District plans to continue the control work on a considerable scale during the spring of 1920. New infestations will be treated, and a careful watch kept on the yellow pine stands from which the epidemic attacks have recently been removed.

The tip moth problem in yellow pine in Nebraska still continues to cause concern. The damage done is as great as in former years, and no feasible way of reducing it is yet apparent. It is believed that the problem deserves serious study by entomologists.

THE 1919 SITUATION ON THE NATIONAL FORESTS

OF MONTANA AND NORTHERN IDAHO.* (A. J. Jaenicke)

At least three insect problems are recognized to exist in the National Forests of this region in November, 1919. These are:

1. The Flathead-Missoula infestation.
2. The concentration of infestation which will follow the extensive 1919 fires, especially in the white pine stands of northern Idaho and western Montana.
3. A small but heavy attack in lodgepole, and a steady loss in the reserved stand on a yellow pine timber sale area, on the Bitter Root Forest.

The Flathead-Missoula Infestation

In 1917, a study of the Flathead-Missoula infestation indicated an insect depredation of an epidemic character in the lodgepole and yellow pine timber on 584,000 acres. The volume of the lodgepole and yellow pine timber was estimated to be 2,404 million board feet, of which only 30 per cent was National Forest timber within the Missoula and Flathead Forests, the remainder being under private and state control. This infestation rose rapidly from an endemic and quiescent condition in 1912 to an epidemic of serious and alarming proportions in 1916. It was impossible to estimate the losses to Government and private pine timber during this four-year period by the mountain pine beetle, but it is safe to assume that it amounted to at least 75 million board feet of lodgepole and yellow pine of good quality.

The same study indicated that this large depredation was then on the rapid decline. The immediate inauguration of control measures was not recommended at that time because of

1. The enormous extent of the infested area and the consequent financial and administrative difficulties in carrying out adequate control measures within a limited time.

*Data from field work by the writer in October and November, 1919, and 1919 reports of forest officers.

2. The difficulty of securing prompt and adequate financial cooperation of the private owners of the timber lying within the infested area. (The private owners and the state controlled 70 per cent of the infested and jeopardized pine timber).
3. The sudden decline of the infestation in 1917, and the probability that within a few years the epidemic would be controlled by natural agencies with a loss of timber which would not exceed in value the cost of artificial control measures.

A field study by the writer in October and November, 1919, revealed the accuracy of the 1917 predictions. The infestation had reached a quiescent and endemic condition with a surprisingly small loss of yellow pine and lodgepole during the two-year period 1917-1919. Only two relatively small areas, one in the Holland Lake region of the Flathead Forest and the other in the Cottonwood Creek area on the Missoula National Forest, need careful watching. Unfortunately, weather conditions did not permit a detailed field study of these two restricted areas on which some first-class yellow pine is still being killed by the mountain pine beetle. A careful study, early enough in the spring of 1920 to enable the immediate carrying out of control measures in the event that such measures seem desirable, is fully warranted on these two areas.

The White Pine Problem

The large fires in 1910 in the white pine stands of the Coeur d'Alene, St. Joe, and Lolo National Forests were immediately followed by serious insect losses in the slightly fire-scarred white pine timber, and in 1913 and 1914 the mountain pine beetle was doing an enormous amount of damage in the adjacent virgin white pine not touched by fire. For instance, on the St. Regis drainage* in western Montana the greater part of the mature white pine which survived the 1910 fire was in a few years wiped out by insects. On this drainage area alone the loss from insects amounted to 10-15 million feet of white pine worth \$4.00 per thousand. Other specific instances indicating just as heavy losses in valuable white pine timber after the 1910 fires could be cited.

*Data from former Supervisor Elers Koch, of the Lolo Forest in December, 1916.

The disastrous fires in the white pine region of western Montana and northern Idaho during 1919 will undoubtedly bring a recurrence of similar epidemic insect losses. As a consequence the Forest Service may have to cope with an insect situation very soon which will be a menace to some of the best white pine in District 1. Privately owned timber in the same region has the same danger to face. To my mind this is at present the biggest insect problem in District 1. The recent establishment of the forest insect station at Coeur d'Alene by the Bureau of Entomology for the study of white pine problems is a timely one, and it is hoped that during 1920 the finances of the Station will permit field study of the fire-damaged and adjacent uninjured white pine stands. Insects play an important role in limiting the time of the merchantability of fire-killed white pine. Pernot's study of 1912 indicates this, and further study both by entomologists and forest pathologists is needed on this problem. But for the present, the insect losses in living white pine stands is the pressing one.

Bitter Root Infestations

On the Bitterroot National Forest, in the East Fork drainage, an infestation by the mountain pine beetle in a pure lodgepole stand has killed about 50 per cent of the merchantable stand over 10 inches D.B.H. on an area of 3,500 acres. This loss has occurred over a period of approximately seven years and the annual loss has been fairly constant. The depredations are still going on, and about 1200 trees are estimated to be infested now (November, 1919). Control measures will be recommended on this area.

A cut-over area on the Bitterroot National Forest of about 1800 acres, on which perhaps 40 per cent of the yellow pine was left as a reserve stand, is now the scene of a western pine beetle depredation. This is the Lick Creek watershed, which was cut over in the period 1909-1911. About 120 yellow pine trees with a volume of 65 M. feet were killed in 1919. Although the insect loss is not great, yet the high commercial value of the timber on this particular area will warrant the inauguration of control measures. The fever-tick occurs in this watershed and may interfere somewhat with securing the necessary labor to cut the infested timber. The loss in yellow pine cut over areas is a real problem in Montana, Oregon, California, Arizona and New Mexico.

No other active infestations or immediately urgent insect problems were brought to the attention of the writer during his recent detail to District 1.

THE DEFOLIATION OF WESTERN HEMLOCK AND SITKA SPRUCE

ON THE TONGASS NATIONAL FOREST IN 1918 AND 1919.

(A. J. Jaenicke)

Importance of the Spruce and Hemlock Stands

The Sitka spruce and western hemlock stands of southeastern Alaska have for a long time played an important role in the development of the great fishing industry, and to a lesser degree, the mining industry. The Sitka spruce is largely used for saw timber and for salmon boxes, and during the war it was cut also for airplane stock. Western hemlock is employed in large quantities for fish trap piling and for wharves. These two species are destined, however, to play even a greater role in the development of the territory because of their suitability for paper pulp and the close proximity of water power sites for the manufacture of this pulp. It is estimated that of the 70 billion board feet of timber on the Tongass National Forest, 65 per cent of it is hemlock and 20 per cent of it is Sitka spruce. It is evident therefore that any extensive insect depredations in these two species in southeastern Alaska is of consequence to established industries like fishing and mining, and to the paper pulp industry of the future.

Field Work on the Problem

The existence of a defoliation on the Tongass Forest was first reported by Mr. Asher Ireland of the Forest Service in the summer of 1918 while he was engaged on land classification work. His report indicated that the hemlock and spruce timber along several hundred miles of shore line between Petersburg and Juneau was being defoliated by some insect. Infested material was sent to the Bureau of Entomology. The situation seemed to be of sufficient seriousness to warrant special study, and it was arranged to have Mr. Carl Heinrich, forest Lepidoptera specialist of the Bureau spend a few months on the infested areas during the 1919 field season. Mr. Heinrich's subsequent temporary detail to the cotton boll weevil work in the South upset these plans. Accordingly, the writer made a field trip on the Tongass during August and September, 1919, the primary purposes of which were:

1. To send sufficient material to the Bureau of Entomology to enable a determination of the insect or insects responsible for the damage.

2. To determine the extent and seriousness of the defoliations on the Tongass, and the feasibility of control measures.
3. To locate suitable areas for intensive study of the entomological features of the problem by a Bureau representative, if such a study seemed desirable.

The Insect Situation in 1919

The results of the field work will be discussed in a detailed report, but in brief they are as follows:

1. The defoliation is largely confined to hemlock. Defoliation in spruce occurs only where the hemlock surrounding it is infested very severely.
2. The defoliations exist on at least 12 distinct areas on the Tongass which are widely separated. Nothing is known of the conditions in the interior of the islands, or in the timber back of the coast lines of the mainland.
3. No extensive killing of timber has resulted from these attacks in spite of the great loss of foliage from the trees, and no large loss is anticipated.
4. The timber losses are small because the defoliators do not seem to work as heavily on the same area during the second year, thus enabling the defoliated timber to at least partially recover after one year's damage.
5. No control measures are warranted or even possible.
6. The problem is worthy of further study by the Bureau from the entomological aspect, and suitable areas are readily accessible for this purpose from Juneau, Sitka, Petersburg and Ketchikan.

No definite identification of the insects responsible for these depredations are yet available. A saw fly, as well as a small Lepidopterous insect, is involved in the damage.

THE INSECT PROBLEMS ON THE NATIONAL FORESTS

OF ARIZONA AND NEW MEXICO
(Messrs. Jaenicke and Hopping)

In order of their importance the following are believed to be the more important insect problems in District 3:

1. The depletion of the reserve stand on yellow pine cut-over areas by *Dendroctonus* species. These insect losses are far greater on cut-over areas than any which have yet been discovered in virgin stands of yellow pine in the region. Most of the damage occurs within a few years after cutting and occasionally is serious enough to wipe out one-third of the stand left for seed trees and a second cut. Both preventive and control measures deserve consideration.
2. The exact relation, if any, which exists on yellow pine timber sale areas between the disposal of brush, logging debris, cull logs, etc., and subsequent infestation in standing timber and reproduction. This problem is a knotty one which deserves prompt and impartial investigation, either independently by the Bureau or cooperatively by the Bureau and the Forest Service. It is exactly the same problem which is prevalent on yellow pine timber sale areas in Oregon and California.
3. Infestations by *Dendroctonus* species in virgin yellow pine stands. No serious attacks are now known to exist in the District, but the quantity of standing insect-killed timber in parts of the District indicate the possibility of their recurrence in the future.
4. Occasional depredations by *Dendroctonus* beetles in Douglas fir and Engelman spruce stands.
5. The tip-moth and may-beetle problem in yellow pine plantations. Both of these pests still continue to do damage in the District, and no feasible cheap methods of control in field plantations are known.

PART IV. RECOMMENDATIONS AND RESOLUTIONS OF THE 1919

ASHLAND CONFERENCE

California 1920 Insect Surveys and Control Operations

Recommendations for this work, together with the necessary allotments are summarized on page 23 of this report, and discussed in some detail in the sections immediately preceding this page.

INFORMAL RESOLUTIONS

Publicity

Since the forest insect problems of the Rocky Mountain and Pacific Coast regions must be better known, both among foresters and timber land owners, in order to receive the consideration which these problems justly deserve in forest protection matters, that the members of this conference make a serious effort during 1920 to secure the publication of general articles in such publications as the Journal of Forestry, The Timberman, The American Lumberman, American Forestry, The Patrolman, etc.

Cooperation

Since the cooperative relations which have existed during the past three years between the western representatives of the Bureau and the insect control men in the Forest Service have been productive of such good results, even with the financial limitations which have existed in the carrying out of control projects, that every effort be made to make the Ashland Conference Plan even more effective and to extend the cooperative study of insect control problems to all control projects which lend themselves to such investigations. (Methods of collecting data have been standardized to such a degree that after the approval of a rough working plan, the investigative data can be secured on the less important projects by any single member of the Conference).

Oregon Agricultural College

Inasmuch as it is believed that the private forest protective organizations of the Northwest will make a serious effort to secure state funds for the investigation of forest

insect problems of Oregon by the Oregon Agricultural College, that the Oregon members of this conference keep in close touch with the college officials in the development of its investigative program in order to avoid duplication of effort on the part of state and federal officials.

Enlargement of the Conference

That the Ashland Conference no longer be restricted to the personnel of the Ashland Station and the insect control men of Districts 5 and 6, but be enlarged to include a representative of each of the western forest insect stations which is actively engaged in the study of insect control problems, and the insect control man from each western Forest Service District which has such a man in its organization. Further, that Mr. Ralph Hopping, now of the Dominion Entomological Branch of Canada and who is engaged in the study of forest insect problems in British Columbia similar to those of Montana and the Northwest, be still considered an active member of the Ashland Conference, and that an effort be made to secure his attendance at future conferences. Mr. Hopping is one of the three original authors of the Ashland Conference Plan.

1920 Conference Meeting

That since the Coeur d'Alene Forest Insect Field Station is favorably situated geographically for the convenience of the conference members that Coeur d'Alene, Idaho, be tentatively selected for the 1920 conference, and that this meeting be held in October, if possible, in order to allow adequate time for the consideration of the recommendations by the individual Districts, the Forester, and the Bureau of Entomology.